

The problems of biosciences in contemporary society*

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Ontogeny of the human being

Determining the ontogenetic origin of human beings, and more in general, of the individuality of living things, has always interested biologists and philosophers. This interest has been reinforced by the moral implications inherent to the development of new techniques which make the manipulation of some stages of development possible, such as assisted fertilization and cloning. A new individual (animal or plant) results from the process capable of integrating ever more complex plans of cellular and tissue organization. Starting from the unicellular state which is the zygote—the first cell deriving from the fusion of a spermatozoon with an egg cell, and thus the first copy of this new individual's genome—an adult, composed of about one million billion (10¹⁵) of cells will develop.

This process is ontogenetically programmed and orchestrated by the genome of the zygote, which contains all the necessary information to direct the development program. Biological knowledge allows us to unequivocally establish that the ontogenetic start of the matter-energy process that gives rise to and identifies the new individual is the moment at which the first copy of its genome is formed. This criterion is valid for all

forms of animal and vegetal reproduction, whether natural (fertilization or parthenogenesis) or artificial (assisted fertilization or cloning) and therefore has the universality that makes it safe from any type of criticism, and clears the field of all the other propositions on the ontogenetic beginning of living things. Some people believe that the origin of human individuals takes place when the nervous system appears, roughly around the 14th day of pregnancy (this is also the time limit for the formation of monozygotic twins). Others consider that life starts on the day of uterine implantation (6th to 7th day), while the Catholic Church places the start of life at the time of fertilization, that is, when the membranes of the spermatozoon and the egg fuse. These *a priori* criteria lack universality and should therefore be rejected: not all living creatures form a nervous system or implant into a uterus or derive from fertilization. Philosophers, theologians and thinkers with different positions are united by the clear contradiction of making the ontogenetic start of a new individual coincide with moments of its embryonic development chosen only because they are considered useful to support their aprioristic opinions.

In the debate to develop value judgments of the stages of embryonic development and human life—judgments that any society should necessarily formulate and make its own—it is unacceptable to confuse elements of different nature; scientific data with mere opinions presented as scientific data. Conceptual short-cuts lead only to intellectual short-cuts and foster controversy and sterile argument. If the key problem presently is to establish “the truth” (understood as the positive correlation between the discussion on a process and the process itself) on

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the emergence of the individuality of living beings, then it must be clear that this occurs independently of dogma or the opinions about it. It is obvious that we could even decide that we only have a new individual at the moment of cutting the umbilical cord! Since the time of Plato, science (biology) has not made judgments based on mere opinion, dogma or prejudice, but on demonstrated knowledge (episteme). In order to construct a secular, democratic society, it is more efficient to accept a factual datum and then develop the debate which will lead to the possibility of making decisions (we cannot simply not decide). For example, on the basis of the argument just presented, it is irrefutable, from a biological point of view, that a cryo-preserved embryo cannot simply be considered a mass of cells because it has not yet formed a nervous system. Ontogenetically, the formation of a new individual has already begun. It therefore seems difficult to accept the idea of killing it, either by throwing it away (237,603 discarded from 1 August 1991 to 31 March 1998 in Great Britain alone, [Donaldson report, 2000, pp 32]) or by leaving it frozen for *secula seculorum* (that is, killing it slowly). Since a potentially new individual deserves respect, it would be better to use its cells to participate in the life of someone who is suffering, by using it to derive stem cells.

Some help in deciding the fate of the hundreds of thousands of frozen embryos can be gained from applying the scientific method, rather than drawing on ethical principles or the concept of person, inappropriately dragged into the cause. The concept of person belongs neither to biology nor to factual science; it is only valid in philosophy, law and theology: the mask of "personality" in Greek-Roman theatre and the Holy Trinity and the persona of Christ. For many religions, animals and hurricanes have souls just as human beings do. One suggestion could be to try to make a working definition of ethics, the theory and praxis of the conduct whose aim is happiness, obtained through the possession of goodness. For Aristotle, happiness and goodness are both virtues; for Kant, it is the autonomy to act according to the universals. Nevertheless, it is not easy to determine the factual nature of goodness. Indeed, it is clear that the alleged ethical consensus of humanity remains a fascinating hypothesis: the exploitation of one human being by another, the just war and the whole history of humanity indicate that it is probably mythical. Ethics is determined by religion and by ideology. Religion is adhesion to a vision of the world that is attributed a fundamental option value (*religare* – L. to bind) to the point to which one can even sacrifice one's life in its name. Ideology is a vision and an evaluation of the world with social transcendence (Aristotle's political ethic). We cannot, therefore, pretend that a Hindu, a Christian, or a dialectic materialist have the same ethics. In the complexity of today's world, only an ethic of responsibility can help in making choices, since the common basic element of ethics is responsible conduct (conscious and voluntary), and therefore, decision.

Faced with frozen embryos we have three options (adoption is, in fact, impractical): 1) To leave the embryos frozen for *secula seculorum*. This choice is synonymous with death, albeit slow. 2) To thaw them and then throw them away, thus accelerating their death. 3) To use them for research on cell differentia-

tion; this option implies their death as an individual, but the "life" of the embryo will last, albeit in a diffuse, cellular form, because its cells may offer to humankind important scientific knowledge and could be distributed as reconstructive cell therapy in other individuals participating in life. It is clear that only the third option ensures the life of the embryo, beyond ideological, religious and ethical positions. The decision on their fate should be reduced to "what to do" and not set in a context in which the decision derives from "what they are": we will never find a shared view on this last point. These embryos exist and deserve a better end than being left frozen for eternity (and no one can possibly believe that this would be practical! Abandoned by everyone, sooner or later someone would complain about the costs of their maintenance and they would be eventually destroyed) or being thrown down the sink: they ask to participate, now that they exist, in the matter-energy process that we call life.

First of all, decisions of such an importance must be put in the perspective of global society, considering our current way of life in which a low-cost flight can take us to a country with a completely different cultural background, and considering that people from other cultures now share our living spaces. Thanks to the progress in scientific and philosophical knowledge we have come out from the caves to walk on the moon and we have sequenced entire genomes: knowledge and learning allow us to live our life as we now do. Besides, new information, research and the technological applications deriving from it, lead to cultural, financial and medical benefits and are now the driving force of both social and economic evolution in developed countries and the phenomenon called globalization. These are irrefutable facts, consolidated over centuries of history, European history in particular. In various epochs, Europe has been the melting pot for scientific innovation, social development and artistic creation thanks to a dynamic synergy between geographical proximity and the union of various cultures. Indeed, the European unification of twenty-five countries, with the intention of creating a ring of friendly states that sooner or later will be candidates to enter the community (Turkey in the near future: by 2050 one European citizen in five will be Turkish!), offers a good moment to reflect on issues such as freedom of research, bioethics and stem cells. This unification is occurring in a period which we could call the "biological revolution". Like all revolutions, enthusiasm is tempered by fears. The enormous amount of information that biological research is very rapidly accumulating is profoundly changing our conception of health and disease and even of what a human being is.

There is fierce debate on how and how much of this information should be used to change aspects of human life that could contribute to improving the quality of life itself, in particular of the elderly (given the current demographics of Europe) and of new generations (thanks to techniques of antenatal diagnosis). Biosciences are acquiring a leading role in the current construction of the meaning and evolution of the concept of citizenship: full citizenship cannot be other than full access to the therapeutic opportunities offered by medicine and the biosciences, independently of wealth and of every natural or cultural certitude. These latter therefore come to play a leading

role in enhancing social cohesion, an effect of great relevance in the European context. In consequence, the wide range of social, legal, political, economic, religious, and philosophical questions linked to the development of life sciences seems to be one of the central reference points in any analysis of change in European societies. This is particularly true for the role of politics, with the intrinsic possibility of recognizing valid political alternatives in a democratic society, if this is aimed at developing policies capable of promoting shared values. In a multicultural society, the existence of shared values is an incommensurable good.

The enlarging of the European community presents us with a wide array of laws regulating the practice of scientific research, technological transfer of advances in biological knowledge and access to new therapeutic opportunities in biomedicine. In consequence, effective policies that guarantee all European citizens access to the benefits of the new bioscience technologies must be developed; policies that hopefully, will be based on ethical principles which respect the plurality of values of the twenty-five countries, and which allow the development of homogenous regulations that are socially oriented to dialogue and to comparison of positions. The ethics of prohibition and an imposition of aprioristic ideologies or religious concepts would only cause a denial of rights (in the sphere of personal decisions) for those who are not rich enough to afford ethical tourism to a nearby country, and encourage social divisions and inequality.

Cloning versus clowning

In a world that has become extremely complex as a result of the ever stronger interplay between science—in particular biology—, its commercial applications and society, some shameful declarations on cloning by charlatans, who do not have the minimal scientific credentials but are capable of exploiting the desires and suffering of people, have been given enormous and perverse publicity. This has created a virtually unprecedented confusion about freedom of research, bioethics and stem cells. Everything has been said about cloning except the one thing that should have been said: reproductive cloning of humans must clearly be forbidden for an extremely simple reason that does not need to tax ethical inventiveness. Were human cloning to be allowed, the woman would be the person to pay the price.

Faced with suggestions of human cloning, ethicists and great public thinkers should simply react on the basis of the information that the scientific community has already produced: there is not a single scientific finding to support the possibility of making a human clone in complete safety, the woman's health would be severely compromised, the antenatal mortality rate would be high and clones born would carry every type of malformation and pathology. Combined with a very high post-natal mortality rate, such technology would result in fewer, less healthy, less beautiful and less intelligent clones, as foreseen by the theory of biological complexity (Morris, 1999). It is therefore very important to explain to the general public that the "no" to

reproductive cloning, clearly expressed by the scientific community, is not based on philosophical disquisitions nor on moral convictions, but on scientific data and bases that make the conceptual scaffolds in favor of human reproductive cloning collapse at first inspection. Furthermore, for cloning, scores of human eggs and surrogate mothers are needed. Who would supply the eggs? Who would act as surrogate mothers? Women from less protected social classes, women who need money and see themselves offered it to undergo gonadotropin hyperstimulation (with very serious consequences for their health) in order to obtain the eggs or to be a surrogate mother: there are already announcement columns in the internet and American magazines looking for "egg donors" who will be richly rewarded.

Commenting on work by Michele Boiani, one of my pupils who was at the University of Pennsylvania at the time, and who demonstrated that even "healthy" clones are, in fact, no such thing if the expression of some genes is considered, Davor Solter (2002) wrote an excellent editorial. This editorial, with the provocative title "Cloning v. clowning", examines all the reasons for and against human cloning and reaches the conclusion that the people who will be most frustrated by Boiani's results are those belonging to "the tribe of answerers, considerers, observers ... whom we know as talking heads", and who have been so busy in issuing judgments and confusing the matter. In other words, precisely those who are largely responsible for convincing political decision-makers on the need for legislation restricting the technique of nuclear transfer, in the fear—we are told—of it being applied to reproductive cloning. This ignores the fact that the donation of eggs between women, on the simple basis of friendship and affection, regulated by a control body, and the technique of nuclear transfer (which is at the basis of cloning) could already avoid the birth of babies carrying the many diseases caused by mutations in the genetic content of mitochondria (some of the muscular dystrophies, for example) and would allow the birth of healthy children, who are the genetic offspring of the couple in which the woman is a carrier of altered mitochondrial DNA. These are the opportunities that we must debate, not those 'do-it-yourself' cloning kits offered by charlatan door-to-door salesmen who unfortunately find a willing audience in alert ministers, and whose knowledge of science is gleaned from a few newspaper titles, often even these being poorly understood. The media should renounce its perverse logic of "not being able to miss news" and insist on a serious debate on subjects that concern us all very closely, because they are more related to our health than to "the future of the human race" and to the "risks of liberal genetics" (Habermas, 2002).

Without correct information we will fall victims to the wicked game of those selling dreams by speculating on suffering, whose sales-talk dictate the subjects considered by philosophers and political decision-makers. These latter have the duty to gather information and not to accept boasted applications as gospel-truth or to make such bragging plausible to public opinion by calling "Nazis" researchers who have been employed for a life-time in sacrifices on salaries that would be humiliating in French-speaking Africa. Philosophers, too, should

study a minimum of biology, to avoid feeding ambiguities in proposing “justified abstention” from applying any technique that is not the mere swallowing of an aspirin. This is the way to create a useful setting in which to establish any restrictions to the freedom of research.

This is just a brief introduction before entering into the crucial subjects of freedom of research and bio-ethics, focusing on one of the central issues of biomedical research, the biology of stem cells. Let us hope that no further confusion will arise on two particular subjects which have been only superficially considered: the biology of stem cells (in other words genetic reprogramming of somatic nuclei) and the fate of cryopreserved embryos.

On the first subject, the biology of stem cells, it is essential to understand that it is historically mistaken to decide *a priori*, on ideological bases, what line of research deserves financing. Somatic stem cells from adults are already an applicative field that, with the studies on trans-differentiation, could give much more. Embryonic stem cells need considerably more study in animal models and a more incisive ethical debate. The alternatives (artificial cytoplasm, as proposed in Dulbecco’s document on stem cell biology, 2000) that involve no ethical dilemmas are still waiting to be taken into consideration for serious financing.

The second subject, the fate of cryopreserved embryos, is worth dealing with first. We must talk about this subject at length and try to understand each other and to find areas of agreement. The scientific community, rather than attempting to answer badly put questions (is this life? when does life start? — life is always life, at any moment of development) must try to explain that applying scientific methodology could contribute to settling the question.

Communicating science to laypeople

Faced with this reality, we must foster interpretative conceptual discussion and direct communication at a European level between the world of life sciences and at least two special groups of civilized society: magistrates and scientific journalists. Magistrates because it would be a good thing to try to develop legal propositions at the same rate as the rapid increase in biological knowledge; and journalists because these could popularize the information thus helping to produce informed citizens that can act and live better in a world that is becoming more and more complex, more polluted, and less rich in natural resources. The scientific community, out of its ivory tower, now understands the importance of engendering great public debate on the role of modern biology in the social changes occurring in Western societies. This is essential in order to increase the participation of citizens in making the crucial decisions on the role of life sciences for creating a more just society. In the great unified Europe, the citizenship’s advancement of knowledge and scientific literacy together with the development of a democratic society based on justice and equality are goals to be striven for: only citizens with the conceptual instruments that allow them to critically evaluate the new frontiers of scientific knowledge can guarantee a democratic system, because they can effectively

and directly influence the social whole with their own autonomous opinions.

Essential prerequisites for achieving these goals are the development of the suitable instruments that allow, on one hand, to analyze the revolution brought about by biosciences and, on the other hand, to explain to the general public the opportunities offered by biotechnologies. Well-informed citizens are a guarantee of strong support for investing resources in scientific research and of autonomous opinions that are reflected in democratic decisions on what is considered licit and on what is not wanted. One example of a correct procedure is certainly that adopted by the English government with its explanatory White Paper on genetics in the national health system (2003), and distributed to all citizens so that there would be democratic control of the production of ethical principles and standards respecting the plurality of values.

Italy: rooted in atavism

Having delineated the idealistic and European *Weltanschauung*, we pass now to an analysis of the situation in Italy. Here, the ideal context in which we would like to act flattens out into a reality in which ethical questions, politico-social reasoning and religious-type arguments appear to be the order of the day. These have not contributed effectively to the development of balanced and carefully pondered positions within civilized society. Indeed, quite the opposite. In the name of ethical principles presumed to be generally valid and accepted by everyone, regulations are made which reflect the *a priori* ideological or religious beliefs of those who are making them and are, therefore, regulations restricting the freedom of self-decision and more in general the freedom of research. The progressive strengthening of this attitude in our country is producing significant changes in our conceptual way of analyzing reality. The effect that these changes will have on meanings and ways of reading social questions, political exchanges, productive-economic dynamics and, more in general and banally, on our everyday life, is still to be determined but will undoubtedly be nefarious. One example of this is the recently approved Italian legislation on assisted reproduction, with which politicians arrogantly took the right of imposing choices on all citizens when these were choices that, at most, would have been accepted by only a part of civilized society. This has led to an unacceptable confusion of roles: politicians, philosophers, theologians and thinkers of various extraction have dealt with human nature (which should be the realm of only biologists and physicians) and not, as they should have done, with only the human condition. The serious consequence of this is that all citizens end up perceiving meanings that are alien to biology as natural facts, as natural things (e.g. the conceptus, the person). The result is a law that is literally and practically eugenic (Sir Francis Galton, Darwin’s cousin, coined this term as long as 115 years ago, in 1892, although he certainly would never have thought of seeing his proposals compulsorily applied as eugenic techniques!) because it considers the State as the depositary of power for defining and imposing (there are severe sanctions) the correct

way of reproducing. In fact, the use of heterologous types of medically assisted reproduction is forbidden, and it has been established that couples must be adults, of different sexes, married or living together, of a potentially fertile age, and that both the partners must be alive. In defining the correct method of reproducing by law, the new Italian legislation is a form of eugenic legislation in clear conflict with article 3 of the charter of Nice which affirms the person's right to integrity and establishes that eugenic practices, in particular those with the aim of selecting a person, must be forbidden in biology and medicine!

However, among the legal maelstrom that this controversial transformation of an ethical position into state law causes, the possibility of research on embryonic stem cells is not implicitly excluded. Bestowing the conceptus with the same rights as those of other subjects is based on a principle of equality. The presupposition for the parity of rights of the conceptus and the adult and, therefore, of unlimited cryopreservation, without the possibility of being used for research purposes, is constituted by the conceptus' potential to become a developed human being. But this potential may not be fulfilled for various external or intrinsic reasons, for instance, if the mother abandons it, or passes the age to carry a pregnancy or dies and there is no other woman willing to offer it the chance to develop, by accepting it in her uterus; if the embryo has been cryopreserved for too long a time and has therefore exceeded the time limit that any prudent gynecologist considers safe for implantation; if the embryo has severe intrinsic abnormalities.

When, for any reason, this potential no longer exists, the subject/conceptus returns to being a mere aggregate of human biological material. Not allowing its use as a source of stem cells, which could help research, is an offence against possible future beneficiaries of treatments which could be found. Furthermore, on the scales of justice, the legal safeguards extended to that group of cells is not justified in the face of the privileged status that our society gives to scientific research: "art and science are free", "the Republic promotes the development of culture and scientific research", states the Italian Constitution in articles 33 and 9. And the Unesco Declaration on the Human Genome (1997) affirms that "States shall ensure the intellectual and the material conditions favorable to the free conduct of research in the human genome, on the basis of the principles set out in this Declaration".

Democracy, rights and philosophy

All this delays the establishment of critically appropriate political/cultural debates capable of redesigning the relationship between democracy and rights, between welfare and democracy, and of identifying the points of contact between scientific research and policies for science. More in general, this means a delay in redefining the state-citizens-welfare relationship, in a framework whose cornerstone is the individual's autonomy to make bio-existential choices, thus contributing to the redirection and relocation of political, economic and social issues in the ongoing debate. In this way, civilized society, and the scien-

tific community in particular, become ever more frustrated waiting for the world of policy-makers to make a genuine effort in developing working guidelines which facilitate the adoption of the policies that could govern the wide range of social and cultural implications deriving from the biotechnology revolution. In this respect, the governance of biotechnological research, genetic engineering, biomedical experimentation, procreation and the end of life is of the most pressing urgency and relevance.

Policy-makers do not seem to appreciate the difference between what is research and development of new techniques, and what is the product of new techniques (e.g. transfer of somatic nuclei, stem cells, cloning). If they are deaf to the voice of scientists, they do, however, show an extraordinary sensitivity to the cries of various thinkers and philosophers, including extremely respectable ones such as Jurgen Habermas, who unfortunately only contribute to distorting the debate and manage to formulate proposals unacceptable to the scientific community and, we hope, to civilized society. In fact, Habermas, incapable of making distinctions, writes that what constitutes the problem is not biotechnology and genetic engineering, but the way and the spectrum of their applications, as a criticism to liberal genetics (completely unknown to the world of biology which recognizes Mendelian genetics, molecular genetics, quantitative genetics etc, but not liberal genetics!). The fact is that the arguments that he drags into play against the dangers of free genetics are arguments against biotechnologies and genetic engineering *tout court* and do not allow, according to him, distinctions to be made between this or that application. In the end, Habermas suggests that we should stop playing around with the human genome, or indeed, with the genomes of all living beings, and invites us in peremptory terms (as Hans Jonas has already done) to close down the laboratories of molecular biology. According to Habermas, the very basis of the ethics of the genus itself, which Habermas identifies in the natural certitude of (natural) sexual reproduction, should be made legally unavailable.

We can continue to consider ourselves as free and equal people only if the casualness, which is ensured by the random mixing of genes at the moment of fertilization, remains inviolable. I find nothing precious about the inherent casualness of birth (to the point of making it the founding value of our form of life) when I think of those, less fortunate in the genetic roulette, who are born with genetic defects that cause suffering and early death. Furthermore, on the simple basis of wealth, Western Caucasians can already avoid many diseases in their own children: a warm welcome should be given to a world as free as possible from suffering and disease, which could already be avoided thanks to the applications of genomic biology.

A novel concept for citizenship

The transfer of applicative opportunities of biology is a process that should be governed, not blocked; governed so that the advances in scientific knowledge bring well-being and equality and do not cause further social discrimination. The serious fact is that these positions find ready listeners among decision-

makers who lack even the minimum basics of biology: the delay in information and education, scientific illiteracy, environmental and health tragedies caused by inefficiency, and statements on the shameful use of some techniques (human cloning), all certainly concur in making the public debate prevail on the problems of ethical, social and legal implications of biological research. In this way, partly out of ignorance and partly to give a little reassurance (and sometimes to not displease the Vatican), policy-makers tend to take a restrictive position, damaging research and its positive biotechnological applications.

A Europe open to the world and dedicated to cooperation without frontiers in order to tackle both the great emergencies of humanity (famine, old and new diseases, draught, the formation and extension of deserts) and the ecological damage in our territory (just think of the black triangle of sulfur emanations between the Czech Republic, Poland and Germany) must promote the development of biotechnologies. What needs to be clarified is the use that these techniques can be put to and their governance (monopolies must be rejected, not the techniques that are currently controlled by the monopolies). We must all make every effort to render the opportunities offered by biotechnology available to all the citizens of the world. In this context, Europe has a great responsibility in becoming a carrier of justice and social equity (which it should export exploiting the instrument that it best knows how to use and that characterizes it: culture) based on biosciences. In order to do this, we cannot continue to stagnate in a context where scientific research must settle things, much more than in the past, with economics and politics: an economic system that views research through the eyes of business (look at the ghastly reform made by the Italian Council for Scientific Research [CNR, Consiglio Nazionale delle Ricerche] and the fortunately unsuccessful attempt to reform the French Centre for Scientific Research [CNRS, Centre National de la Recherche Scientifique] and politics which has lost every strategic direction and has been steam-rolled by the mere logic of profit (with the poorly ethical decision of the Italian Ministry of Universities and Scientific Research (MIUR) to devolve patents to researchers whose research covered by the patent was carried out with public money).

The attitude of the current Italian government towards the world of research is demonstrated by the refusal of the MIUR to sign the European protocol of agreement for the creation of a European Research Council (ERC), formulated by 52 bodies of European research, by the Group of European Nobel prize winners and by other authoritative scientists. The position of the MIUR, substantially against the formation of an ERC, was expressed in a document shakily constructed on—among other things—precisely the three criteria of scientific excellence, independence and bureaucratic streamlining requested many times by the scientific community. Decisions of this enormity (Italy and Poland were the only two member countries that did not sign) were taken without any consultation: not even the *Accademia dei Lincei*, by statute the scientific reference of the President of the Italian Republic, was consulted when considering the refusal expressed in the document, or what is worse, before drafting the definitive version of the document, whose

contents certainly cannot be shared, not least because they are harmful to the prestige of Italian scientists in Europe.

The unification of Europe offers us the possibility of reestablishing, at a national level in some countries including Italy, and consolidating, at a Community level, the procedure of consulting the scientific community as a necessary prerequisite to producing any norms intended to regulate the relationship between citizens and life-sciences. Such a procedure is a guarantee of using factual data as the basis for elaborating ethical values and principles, which in this way can be agreed upon by most people. In a period like the one we live in, in which all values are homologated and all the aspects of daily life are seen through the filter of a market economy, it is easy to forget that a state rests, independently of how it is governed, on two pillars: research and the sharing of its results; that is, education of citizens and their health. The promotion of these two values cannot be homologated or reduced, in other words, by economic constraints to the same level assigned by market logic to other values without overall diminishing a society and impoverishing quality of life in the widest meaning of the term. A simple comparison of the levels of life in rich and poor countries clearly shows that these are two values worthy of investment. Educated, healthy citizens can, obviously, act better and live better in a world that is increasingly complex and less rich in natural resources.

Mankind (some men) can now manipulate existence, and the ethics governing social living can no longer be simply negation. These ethics must now be a responsibility, which compels investment in scientific research. At the same time, this research, carried out within the inseparable concept of conscience—freedom—, can be seen as a voyage towards uncharted territories, as history has taught us, with rules made gradually as we get closer to the goal, and with the intrinsic capacity to produce that information, that advance in knowledge which enriches social life and which is historically converted into products through the capacity of commercial enterprises. Thus mankind translates knowledge into goods: occupation, income, art, etc. Although capitalism and socialism clash on the strategies for distributing these goods, ideally there should be the widest possible consensus on the premise that it is research, science and technological applications of its knowledge that are the driving forces of human evolution.

Science and economy: if Italians were clever

This simple consideration becomes dramatic when considered in the real context of our country. In the current Italian legal system, freedom of research and the obligation of the Republic to promote it are confirmed by two articles of the Italian constitution (art. 9 and art. 33). It does seem however, that prolonged amnesia has afflicted policy-makers and governments, certainly since Quintino Sella—the last government to invest massively in education and research, with Rome the city of knowledge. Adriano Buzzati Traverso (1967) wrote an article entitled “If Italians were clever” to explain how Italy is always complaining about the lack of investment in research but continuously does

everything to exile its best researchers, reminding us that only a country that invests in research is a country able to promote occupation and richness: it really does seem that Italians are not clever.

Recently the Italian scientific community managed to let it be known outside academic circles that the Republic invests less than Tunisia does in research, less than half the investment of other countries (1% versus 2–4%). When this situation is applied to biomedical research, its irrationality becomes even more obvious. There is very clear evidence that investing in medical research means saving, if you don't actually want to say better health! The philosophy that is currently becoming consolidated among countries of the G-7 (the G-7 gathers the seven most industrialized and wealthiest countries in the world: Canada, France, Germany, Italy, Japan, the United Kingdom, the United States)—excluding Italy!—is one of funding first, that is, public money must be invested first of all in research and, in particular, in biomedical research because this can be translated into a financial dividend of exceptional value. In 1998 in the USA, with an investment of 45 billion dollars in biomedical research, about half a million people were employed in the pharmaceutical industry alone (generating total salaries of 120 billion dollars), with sales of about 100 billion dollars. The savings due to prevention of some diseases are impressive: the prevention of post-menopausal osteoporosis led to a saving of 333 million dollars/year in 1998; the investment of 56 million dollars in a 17-year long research program on testicular tumors has led to the positive treatment of 91% of cases with savings of 166 million dollars/year. The social costs of the diseases that affect us are far greater than the research costs capable of preventing them (in the USA, in the last 10 years, there has been an annual saving of 3 billion dollars in the cost of medical treatments for hypertension). Besides the obvious benefits that good health brings, there are financial benefits! [For a detailed analysis, tables and graphs, see the site www.fundingfirst.org].

What has already been agreed is often forgotten: one pertinent example concerns research on stem cells, with outcomes of enormous importance for the right to health, the future prospects of medicine and the productive capacity of a country. Italy has made well-defined agreements on the subject of stem cells, having signed both the Statements of Annecy and of Unesco. The *Marcel Mérieux* Foundation in Lyons organized a conference in Annecy, from 21–23 June, 2000 on the “Science and ethics of stem cells”. This conference was attended by researchers, ethicists and political decision-makers and was chaired by Didier Montarras, Chief of Cell Development at the Pasteur Institute in Paris. Immediately after this conference, the ministers of research of the G8 countries (G7 plus Russia), as well as representatives from Brazil, China, Mexico and India, met in Bordeaux (24–25 June), to draw up a consensus statement which committed all signatories to strongly support research on stem cells. Thus, Italy has precise international duties that commit it to contribute intellectually and financially to development in this sector. As far as the intellectual aspect is concerned, Italy can boast of the existence of groups that have made significant contributions to the advances in scientific knowledge on stem cells, working merely with creativity and

little money. Indeed, we still have human capital to be envied in this sector. The duty to participate actively in the economic investment should therefore be clear. This should be done by financing the already active groups and promoting the education of young biomedical scientists devoted to stem cell research: this is a duty, not only freedom.

Without adequate finance (duty), there is only an illusion of democracy (freedom) in Italy. Furthermore, the scientific community is completely frustrated by the position taken by the current Government in regards to the “research system”. This position can be traced back to the not very cunning and slightly naïve idea of reorganizing the system along the lines of a business, with its business mission being applied research, both as a prerequisite for encouraging private investment in research and to make the system work better. For the sake of correctness, this position should have been made explicit at the time of promises of a substantial supply of funds, made during the 2001 electoral campaign. However, the most authoritative journals in the sector of research management (*Research Policy*, *Nature*, *Science*) suggest that the direction to follow should be not privatization of public research but rather strong public investment in research. Telling researchers that they can patent the results of their research (a not very ethical suggestion: using public facilities for personal profit) sounds very much like “gird yourselves and leave”. The researcher must find funds and then administer them, thus carrying out a sort of “scientific prostitution” which forces Universities to do only what the market place wants. Thus the government's duty to guide the great strategic priorities becomes weaker and the state is cut out of the possibility of making the voice of the public heard concerning the choice of applications; the lesson of OGM (and what is happening with stem cells) has not taught us anything. The real underlying logic of this arrangement is that the state is withdrawing from its own responsibilities in investing in research, covering up the operation as a great opportunity for the freedom for researchers.

Freedom for researchers means funds for research. In Italy, researchers were already free to carry out the research they desired but they have always had this freedom curtailed by a chronic lack of funds. In fact, we are being proposed the transformation of universities into registered companies, flying in the face of experience in countries such as the United States of America and the United Kingdom, which invest heavily in public research (President Bush has increased state investment in biomedical research by 15%), aware that the financial return for the country in the medium-short term is equivalent to an annual profit of 28%. No one in the USA would dream of converting a public asset into a business, not least because it simply is not financially advantageous. The commitment to bring the funds for research to 1% of the GDP to realign our country has a sinister ring: one wonders what country Italy wants to be aligned with? The European average is 1.8% of the gross domestic product (GDP)!

Recent studies carried out by American economists identified various different types of contributions that publicly financed research can bring to the growth of a country. Publicly funded research: (a) expands scientific and technological op-

portunities which can be made available to society and to businesses for their activities (e.g. sequencing the human genome); (b) forms qualified graduates; (c) creates new scientific instruments and methodologies because basic research compels researchers to develop new equipment, techniques, and methods of analysis; (d) establishes networks of scientific collaboration and social interaction in which interest is in collaboration or healthy competition, but certainly not in making results obtained secret. The possibilities of collaboration are more restricted in private research and there is a tendency to use existing resources, blocking a company within some particular technological options (a universally known example is the monopoly of the software market, which has undoubtedly also slowed its development); (e) universities often act as catalysts around which new commercial enterprises develop, creating regional agglomerations in which public and private collaboration leads to the development of financially very substantial sectors. There are excellent examples in Italy in the electronics sector (the so-called Sicilian "silicon valley") and in the biotechnologies sector. Research is now the driving force of social and economic evolution of countries and it is imperative that all squabbles and litigation between the current government and past ones are abandoned so that funds are made available in order to unleash the potential of Italian researchers who constitute a rich human capital and a source of new knowledge.

The political class must be made aware that, without adequate investment in research, the economic, social and cultural

levels reached in our country are at risk. Furthermore, the very role of Italy is threatened, as are its productive potential, its place in international financial competition, its responsible use of natural resources, and its participation (dictated by our history) in processes of solidarity for a more just development of populations from economically disadvantaged regions.

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